1. A method for predicting a value of a property of processed material, the method comprising the steps of:

(a) providing a process description comprising at least one governing equation;

(b) obtaining a characterization of a flow of a material using the process description;

(c) obtaining a morphological characterization of the material using the characterization of the flow of the material; and

(d) predicting a value of a property of the material using the morphological characterization.

2. The method of claim 1, wherein the process description comprises a representation of an injection molding process.

3. The method of claim 1, wherein the process description comprises a representation of at least one member of the group consisting of an extrusion process, a blow molding process, a vacuum forming process, a spinning process, and a curing process.

4. The method of claim 1, wherein the at least one governing equation comprises conservation of mass, conservation of momentum, and conservation of energy equations.

5. The method of claim 1, wherein step (d) comprises predicting an elastic modulus of the material.

6. The method of claim 5, wherein the elastic modulus is one of the group consisting of a longitudinal Young's modulus, a transverse Young's modulus, an in-plane shear modulus, an out-plane shear modulus, and a plane-strain bulk modulus.

7. The method of claim 1, wherein step (d) comprises predicting a complex modulus of the material.

8. The method of claim 7, further comprising the step of:

(e) predicting a value of a property of the material from the complex modulus.

9. The method of claim 1, wherein step (d) comprises predicting at least one member of the group consisting of a mechanical property, a thermal property, and an optical property.

10. The method of claim 1, wherein step (d) comprises predicting at least one of a thermal expansion coefficient, a thermal conductivity, a bulk modulus, and a sound speed.

11. The method of claim 1, wherein step (d) comprises predicting at least one of clarity, opaqueness, surface gloss, color variation, birefringence, and refractive index.

12. The method of claim 1, wherein step (d) comprises predicting at least one component of a stress tensor.

13. The method of claim 12, wherein the stress tensor comprises a measure of flow-induced stress.

14. The method of claim 1, wherein the morphological characterization comprises at least one component of a conformation tensor.

15. The method of claim 1, wherein the morphological characterization comprises at least one component of an orientation tensor.

16. The method of claim 1, wherein the morphological characterization comprises a measure of crystallinity.

17. The method of claim 16, wherein the measure of crystallinity is a measure of relative crystallinity.

18. The method of claim 1, wherein step (c) comprises obtaining the morphological characterization using a description of crystallization kinetics of the material.

19. The method of claim 18, wherein the description of crystallization kinetics of the material comprises a dimensionality exponent.

20. The method of claim 18, wherein the description of crystallization kinetics of the material comprises a description of flow-induced free energy change.

21. The method of claim 18, wherein the description of crystallization kinetics of the material comprises a description of flow-induced nucleation.

22. The method of claim 1, wherein step (c) comprises obtaining the morphological characterization using a two-phase description of the material.

23. The method of claim 22, wherein the two-phase description comprises at least one of a crystallization kinetics model, an amorphous phase model, and a semi-crystalline phase model.

24. The method of claim 22, wherein the two-phase description comprises a crystallization kinetics model, an amorphous phase model, and a semi-crystalline phase model.

25. The method of claim 22, wherein the two-phase description comprises a viscoelastic constitutive equation that describes an amorphous phase.

26. The method of claim 25, wherein the viscoelastic constitutive equation comprises a FENE-P dumbbell model.

27. The method of claim 25, wherein the viscoelastic constitutive equation comprises at least one of an extended POM-POM model and a POM-POM model.

28. The method of claim 25, wherein the viscoelastic constitutive equation comprises at least one of a Giesekus model and a Phan-Thien Tanner model.

29. The method of claim 22, wherein the two-phase constitutive description comprises a rigid dumbbell model that describes a semi-crystalline phase.

30. The method of claim 1, further comprising the step of:

(e) performing a structural analysis of a product made from the processed material using the value of the property of the material.

31. The method of claim 30, wherein step (e) comprises predicting warpage of the product.

32. The method of claim 30, wherein step (e) comprises predicting shrinkage of the product.

33. The method of claim 30, wherein step (e) comprises predicting how the product reacts to a force.

34. The method of claim 30, wherein step (e) comprises predicting at least one of the group consisting of crack propagation, creep, and wear.

35. The method of claim 30, wherein step (e) comprises predicting at least one member of the group consisting of impact strength, mode of failure, mode of ductile failure, mode of brittle failure, failure stress, failure strain, failure modulus, failure

flexural modulus, failure tensile modulus, stiffness, maximum loading, and burst strength.

36. The method of claim 1, wherein obtaining the flow characterization comprises using a dual domain solution method.

37. The method of claim 1, wherein obtaining the flow characterization comprises using a hybrid solution method.

38. The method of claim 1, wherein step (b) is performed after each of a plurality of time steps associated with a solution of the at least one governing equation in step (a).

39. The method of claim 1, wherein steps (b) and (c) are performed after each of a plurality of time steps associated with a solution of the at least one governing equation in step (a).

40. The method of claim 1, wherein steps (b), (c), and (d) are performed after each of a plurality of time steps associated with a solution of the at least one governing equation in step (a).

41. The method of claim 1, wherein step (c) comprises performing one or more crystallization experiments to determine one or more parameters used to obtain the morphological characterization.

42. The method of claim 1, wherein step (c) comprises performing one or more crystallization experiments to determine a crystal growth rate of the material under quiescent conditions.

43. The method of claim 1, wherein step (c) comprises performing one or more crystallization experiments to determine a half-crystallization time.

44. The method of claim 1, wherein step (c) comprises performing one or more experiments to determine at least one of a relaxation spectrum and a time-temperature shift factor.

45. A method for performing a structural analysis of a manufactured part, the method comprising the steps of:

(a) providing a process description comprising at least one governing equation;

(b) obtaining a characterization of a flow of a material using the process description;

(c) obtaining a morphological characterization of the material using the characterization of the flow of the material;

(d) predicting a value of a property of the material using the morphological characterization; and

(e) performing a structural analysis of a part made from the material using the predicted value of the property.

46. The method of claim 45, wherein step (e) comprises creating a structural analysis constitutive model.

47. The method of claim 45, wherein step (e) comprises predicting a response of the part to a load.

48. The method of claim 45, wherein step (e) comprises predicting warpage of the part.

49. The method of claim 45, wherein step (e) comprises predicting at least one member of the group consisting of warpage, shrinkage, crack propagation, creep, wear, lifetime, and failure.

50. A method for designing a part, the method comprising the steps of:

(a) providing a test design of a part, wherein the part is made from a material;

(b) providing a process description comprising at least one governing equation applied within a volume, wherein the volume is based on the test design of the part;

(c) obtaining a characterization of a flow of the material using the process description;

(d) obtaining a morphological characterization of the material using the characterization of the flow of the material;

(e) predicting a value of a property of the material using the morphological characterization;

(f) using the value of the property to evaluate a measure of part performance; and

(g) determining whether the measure of part performance satisfies a predetermined criterion.

51. The method of claim 50, wherein the method further comprises the step of:

(h) modifying the test design in the event that the measure of part performance does not satisfy the predetermined criterion.

52. A method for designing a manufacturing process, the method comprising the steps of:

(a) providing a test set of inputs for a process for manufacturing a product from a material;

(b) providing a description of the process, the description comprising at least one governing equation;

(c) obtaining a characterization of a flow of the material using the description of the process and the test set of inputs;

(d) obtaining a morphological characterization of the material using the characterization of the flow of the material;

(e) predicting a value of a property of the material using the morphological characterization;

(f) using the value of the property to evaluate a measure of product performance; and

(g) determining whether the measure of product performance satisfies a predetermined criterion.

53. An apparatus for predicting a value of a property of processed material, the apparatus comprising:

(a) a memory that stores code defining a set of instructions; and

(b) a processor that executes the instructions thereby to:

(i) obtain a characterization of flow of a material using a process description comprising at least one governing equation;

(ii) obtain a morphological characterization of the material using the characterization of flow of the material; and

(iii) predict a value of a property of the material using the morphological characterization.

54. A method for predicting a value of a property of processed material, the method comprising the steps of:

(a) providing a process description comprising at least one governing equation;

(b) obtaining a characterization of a flow of a material using the process description;

(c) providing a two-phase description of the material, wherein the description is based in part on the characterization of the flow of the material;

(d) obtaining a morphological characterization of the material using the two-phase description; and

(e) predicting a value of a property of the material using the morphological characterization.

55. The method of claim 54, wherein the material undergoes a change of phase during processing.

56. The method of claim 54, wherein the two-phase description comprises an amorphous phase model and a semi-crystalline phase model.

57. A method for simulating fluid flow within a mold cavity, the method comprising the steps of:

(a) providing a representation of a mold cavity into which a material flows;

(b) defining a solution domain based on the representation; and

(c) solving for a process variable in the solution domain at a time *t* using at least one governing equation, wherein step (c) comprises the substep of using a morphological characterization of the material in solving the at least one governing equation.

58. The method of claim 57, wherein the substep of using a morphological characterization of the material in solving the at least one governing equation comprises determining a viscosity of the material based at least in part on the morphological characterization of the material.

59. The method of claim 57, wherein the substep of using a morphological characterization of the material in solving the at least one governing equation comprises determining a viscosity of the material based at least in part on the morphological characterization of the material at a time prior to the time *t*.

60. A method for predicting a morphological characteristic of structures within a manufactured part, the method comprising the steps of:

(a) providing a model of at least one stage of a manufacturing process;

(b) obtaining a characterization of flow of a material, where the flow occurs during the at least one stage of the manufacturing process; and

(c) predicting a morphological characterization of structures within at least a portion of a manufactured part using the flow characterization.

61. The method of claim 60, wherein step (c) comprises predicting an orientation of crystallites within the manufactured part.

62. The method of claim 60, wherein step (c) comprises predicting a size distribution of crystallites within the manufactured part.

63. The method of claim 60, wherein step (c) comprises predicting a crystal volume as a function of position within the manufactured part.

64. The method of claim 60, wherein step (c) comprises predicting an orientation factor as a function of position within the manufactured part.

65. The method of claim 60, wherein step (c) comprises predicting the morphological characterization using a description of crystallization kinetics of the material.

66. The method of claim 65, wherein the description of crystallization kinetics comprises an expression for excess free energy.

67. The method of claim 60, wherein the manufacturing process is an injection molding process.

68. The method of claim 1, wherein step (d) comprises predicting material property values at a plurality of locations within a part made from the processed material.

69. The method of claim 1, wherein step (d) comprises predicting material property values of a part having an arbitrary geometry, where the part is made from the processed material.

70. The method of claim 3, wherein the process description comprises a representation of at least one member of the group consisting of a profile extrusion process, a blow film extrusion process, and a film extrusion process.

71. The method of claim 45, wherein step (e) comprises predicting a response of the part to a thermal load.